ISSUES, IDEAS AND INFORMATION FOR PSYCHOLOGY STUDENTS

NO.2 - ANIMAL COMMUNICATION

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1. DIFFERENT TYPES OF ANIMAL COMMUNICATION

1.1. INTRODUCTION

"Communication occurs when one animal's behaviour can be shown to have an effect on the behaviour of another" (Dawkins 1995 quoted in Wyatt 2003 p3).

Communication involves signals, which are "changes in the environment caused by one individual (the emitter) which can convey information to another (the receiver)" (Endler 1993).

The main types of communication are visual, auditory, chemical, tactile, and electrical. The method used will depend upon a number of key factors (table 1.1).

FACTORS IN	EXAMPLE
Interference	Auditory communication limited by background noise and visual communication by amount of
Distance	Sound travels further in water
Medium of	Air, water, substrate (land)
Timing	Chemical messages can be longer lasting
Permanent or	Red deer stags grow antlers in breeding season
Need for attentiveness	Visual communication needs receiver to be attending to sender. This is overcome by the use of alerting signals before the "main"

Table 1.1 - Key factors affecting the method of communication.

The process of sending and receiving messages can be exploited in two ways:

- By eavesdropping - unintended receiver "overhears" the sending of the message. For example, calls between mother and offspring are heard by predator;

- By deception - the emitter sends a message that fools the receiver. For example, a harmless species mimicking a harmful species deceives the predator of the harmless species.

1.2. VISUAL COMMUNICATION

This covers any communication involving vision (tables 1.2 and 1.3):

- Body colours and displays;

- Postures (whole body) eg: African hunting dog pups take ritualised begging position which triggers regurgitation of food by parents;

- Gestures (part body) eg: tail wagging of dogs;

- Movement displays.

ADVANTAGES

1. Medium range; ie: as far as animal can see.

2. Fast rate of change of signal.

3. Fast exchange of information between animals.

4. High complexibility of message.

5. Low energy costs compared to other forms of communication.

6. Easy to localise origin of sender.

7. Allows private communication between two animals without others knowing.

8. Permanent and enduring message if body colours.

9. In darkness some animals can produce own light; eg: fireflies, jellyfish.

10. Useful in crowded environment; eg: male fiddler crabs wave massive claw to attract females.

11. Instantaneous communication.

12. Stands out from background or camouflage depending upon purpose.

13. Many channels of visual communication - eg: motion speed and direction, brightness and hue (Endler 1993).

DISADVANTAGES

1. Limited use in environments with physical obstacles like forests and jungles.

2. No use in darkness or poor light.

3. Colour displays attract predators.

4. Needs attention of recipient.

5. If problems with attention, alerting signal may evolve before the "main" signal. This requires extra energy and increases risk of predation.

6. Needs sender to be physically present, so limited use if depending very large territory.

7. Signal limited by small body size.

8. Need to meet conspecifics to work.

9. Postures are short-lived and use higher levels of energy.

10. Not long range.

11. Can be exploited by deception; eg: "Batesian mimicry" (dishonest signal) palatable prey look like unpalatable prey; the narcissus fly (Merodon equestris) mimics the red-tailed bumble-bee (Bombus lapidarius).

12. Requires receiver to have appropriated developed eyes (and brain) to see.

13. Cannot hide body colours.

Table 1.2 - Advantages and disadvantages of visual communication.

CRITERIA	VISUAL COMMUNICATION
Range/distance	Medium; depends on visual system of
Rate of change of signal	Fast
Ability to pass obstacles	Poor
Rapid exchange between	Fast
Locatability of sender	High
Complexity of signal	High
Energy cost of communication	High
Durability of signal	Variable
In darkness	Not good

Table 1.3 - Effectiveness of visual communication.

1.2.1. Examples of Visual Communication

Peacock Butterfly

Vallin et al (2005) tested experimentally peacock butterflies' (Inachis io)(figure 1.1) visual intimidation of blue tits (predators). The eyespots are a visual signal and example of prey using intimidation by bluffing.

There were six conditions of butterfly:

a) No eyespots, but sound (eyespots painted over with marker pen);
b) No sound, but eyespots (wings cut to stop sound production);
c) No eyespots or sound;
d) Eyespots (but painted at base of wings);
e) Sound (wings cut but sound production still possible);
f) Eyespots and sound intact.

It was found that eyespots were more important in defence than sound alone. half the butterflies in condition (a) (5/10), producing sound only, were attacked and consumed by the blue tits, but none in conditions (b) (0/8) and (d) (0/9) with eyespots.

(Source: Jorg Hempel)

Figure 1.1 - Peacock butterfly.

Lions

Among lions a dominant male, or usually males, will tend to control the pride, at least temporarily for two or three years. But the position of this male is regularly challenged by nomadic males. Thus the strength of the male has to be obvious to discourage attackers.

One sign is the mane. Researchers attempted to identify the importance of the mane using "dummy male lions". One experiment gave the choice of a "dummy male" with large or sparse mane. The latter model was approached most by male lions suggesting seen as least threatening. The second experiment gave a choice of the same length of mane, but either dark or light coloured. The latter again was attacked more often.

The mane is expensive in evolutionary terms because it limits the loss of heat in high temperatures. More so with large, dark manes which are seen as a sign of strength by other males. Only the strongest animals can survive such demands on their body (Caputo 2002).

1.3. AUDITORY/ACOUSTIC COMMUNICATION

This is communication involving sound in some form (tables 1.4 and 1.5) including:

- Variations in pattern, pitch, and volume;
- Vibration of body parts, like crickets;
- Echolocation - sending and receiving sound echoes to "see" what is around (eg: bats);
- Use of external equipment (eg: vibration of leaf).

ADVANTAGES

1. Allows for fast exchange of information.

2. Versatile in terms of frequency and intensity changes, and repetition of message.

3. Useful over long distances.

4. Adaptable in various habitats; eg: low frequency calls penetrate dense vegetation.

5. Effective in darkness.

6. Complex messages can be sent; eg: different alarm calls for different predators.

7. Does not need visual contact.

DISADVANTAGES

1. Can be abused by eavesdroppers.

2. Can be abused by deceptive calls from predators.

3. Sender can make their position known to predators.

4. Prone to interference and background noise; eg: other calls in group.

5. Expensive to produce.

6. Requires receiver to have appropriate equipment and/or frequency range of hearing.

7. Short-term only and quickly lost.

Table 1.4 - Advantages and disadvantages of auditory/acoustic communication.

CRITERIA	AUDITORY/ACOUSTIC COMMUNICATION
Range/distance	Low (further in water or
Rate of change of signal	Fast
Ability to pass obstacles	Good
Rapid exchange between	Fast
Locatability of sender	Medium
Complexity of signal	High
Energy cost of communication	High
Durability of signal	Low
In darkness	Good

Table 1.5 - Effectiveness of auditory/acoustic communication.

1.3.1. Examples of Auditory/Acoustic Communication

Frogs

Frogs tend to call for mating (advertising presence), warning, distress, territorial ownership (more than one type of call in some species), release (male gives when clasped by another male or given by a female not sexually receptive), and a rain call (McFarland 1981).

Calling requires a lot of energy, particularly to produce the loudest sound, and the ability to use up the energy is taken as a sign of a "good individual". Male Gray Treefrogs (Hyla chrysoscelis)(figure 1.2) use more

energy (as measured by oxygen consumption) at the fastest calling rate (eg: 1500 calls per hour) than forced exercise (Taigen and Wells 1985).

(Source: US Geological Survey)

Figure 1.2 - Gray treefrog.

Male Tungara frogs (Physalaemus pustulosis) produce whining calls which end with "chucks". Ryan (1985) compared sonograms of five calls of increasing complexity, and found females prefer males giving "chucks" as well as whines.

But the characteristic of the call that matters is the frequency of the "chuck". Ryan (1980) using a choice of two calls, from speakers in opposite parts of a pond, found that females went towards the lower-pitched "chucks". This type of "chuck" requires more energy to produce (up to 20 times more), and so is a signal of the size of the frog. The complex call is also easier for the female to locate, but so can bats.

Large frogs produce lower-pitched "chucks", and thus can be found by females as males aggregate together in the pond. The frequency of the call decreases with increasing body size (Ryan 1985).

There is a trade-off for the males between conserving energy, beating the competitors to a female, and avoiding predators.

Obvious communication like calling has the downside of "illegitimate receivers" or "eavesdroppers" - ie: predators: Fringe-lipped bats (Trachops cirrhosus) for Tungara frogs.

The key is to attract mates but not predators. Certain strategies have evolved to deal with this dilemma.

- Stop calling when detect flying bat, or cardboard model in the case of experiments (Tuttle et al 1982). But this would not happen on cloudy nights among Mud-puddle rain forest frogs, who suffered high levels of predation on such nights (Tuttle and Ryan 1981).

- Males can adapt their calls to narrow-frequency whines only when alone. Fringe-lipped bats respond to calls with "chucks" at the end in speaker experiments (Ryan 1983). Thus when alone, it is more important to survive than to mate. Females with no other choices will mate with frogs that produce whines only.

- Calling while in large choruses is safer for the individual because there is less chance of being the chosen victim.

Tree Swallows

The begging behaviour of nestling birds involves brightly coloured gapes and excessive loud calls. This seems more intense than necessary considering the predation costs of making too much noise. So why do nestlings call so loudly when the parent(s) return with food? There are a number of possible answers (Leonard and Horn 2001):

i) There are many birds in a nest and an individual has to call loudly to gain the parents' attention (Dawkins and Guilford 1997);

ii) An exaggerated begging call manipulates the parent(s) to give more food than the parent(s) want. This is part of the parent-offspring conflict theory (Trivers 1974) which explains parent and offspring behaviour in terms of a struggle for resources. The individual offspring wants more from the parent(s), whereas the parent(s) want to spread this resource across all current (and future) offspring;

iii) Parent(s) are unable to assess the offspring's needs and have to be encouraged to feed the offspring (Godfray 1991).

Leonard and Horn (2001) tested these explanations with the begging calls of nestling tree swallows (Tachycineta bicolor)(figure 1.3) taken from the Gaspereau Valley of Nova Scotia, Canada. The Birds were placed in artificial nests in the laboratory at 6-7 days old.

In experiment 1, the begging calls were recorded during varying amounts of time without food (up to 80 minutes), and experiment 2 reduced the temperature of the artificial nests.

Begging call length increased with food deprivation. From an average of 20 milliseconds at the baseline (after feeding) to 35 milliseconds after eighty minutes without food. The rate and frequency of calls varied with temperature. Large and small nestlings also showed different changes in calls in response to hunger and cooling. Overall, it seems that a nestling's begging call was an individual measure of their state which competed against the calls of other nestlings. This would seem to support a combination of explanations (i) and (iii) above.

(Source: KenThomas.us)

Figure 1.3 - Tree swallow.

1.4. CHEMICAL COMMUNICATION

This type of communication is based upon the use of chemicals and includes olfactory (odours/smell), pheromones, and taste (tables 1.6 and 1.7).

ADVANTAGES

1. Can travel long distances in right medium.

2. Unaffected by obstacles.

3. Does not require the attention of the receiver.

4. Able to reach moving receivers.

5. Effective in darkness.

6. Potent so only small amounts needed.

7. Have longer life than other forms of communication; eg: good way to signal territorial boundary.

8. Work in water, on land, and in air.

9. Good indicator of fitness (Endler 1993).

DISADVANTAGES

1. Transmission distance depends on medium.

2. Depends upon receiver having appropriate receptor cells.

3. Rapid fading of some chemicals.

4. Affected by poor weather; eg: rain washes away signal left on land.

5. Expensive to manufacture.

6. Slow compared to other methods and not very flexible.

7. Hard to switch on and off quickly.

8. Not easy to locate sender accurately sometimes.

9. Low directional control, depends on water current/airflow.

Table 1.6 - Advantages and disadvantages of chemical communication.

The chemicals involved in this type of communication are technically known as "semiochemicals" (Law and Regnier 1971). Pheromones are a sub-type of these used for communication within species. Karlson and Lüscher

(1959) defined them as "substances secreted to the

CRITERIA	CHEMICAL COMMUNICATION
Range/distance	Depends on medium
Rate of change of signal	Slow
Ability to pass obstacles	Good
Rapid exchange between	Slow
Locatability of sender	Variable, but can be difficult
Complexity of signal	Low
Energy cost of communication	Varies
Durability of signal	High
In darkness	Good

Table 1.7 - Effectiveness of chemical communication.

outside by an individual and received by an second individual of the same species in which they release a specific reaction, for instance a definite behaviour (releaser pheromone) or developmental process (primer pheromone)".

When pheromones are eavesdropped as in predator beetles using them to locate bark beetle prey, the pheromones are called "kairomones". When bolas spiders lure male moths by the deceptive use of moth pheromones, for example, the pheromones are known as "allomones" (Wyatt 2003).

Pheromones are usually left on land or released into air or water. But they can also be transferred directly; eg: male terrestrial salamanders (Plethodon jordani) transfer pheromones from the chin gland to the nostrils of the female, while another male salamander injects his pheromone into the female's blood supply (Wyatt 2003).

1.4.1. Examples of Chemical Communication

Ants

Ants communicate by cuticular hydrocarbons. These are chemicals on the skin surface. For example, red harvester (Pogonomyrmex barbatus) ants that leave the nest regularly are exposed to drier conditions in the desert air, than those who stay in the nest, and this produces more n-alkanes to n-alkenes (Greene and Gordon 2003).

Ants send out scouts to look for food and they return to communicate to foragers to collect that food. Greene and Gordon (2003) caught returning red harvester ant scouts who had found food, extracted their cuticular hydrocarbons, and then artificially stimulated the nest

with beads coated in certain of those hydrocarbons. The hydrocarbons from scouts stimulated foragers to leave the nest whereas uncoated beads (control) or beads covered with hydrocarbons from nest-maintenance ants did not.

Moths

Female tiger moths (Utetheisa ornatrix) choose males with the most pheromone because the substance is derived from plant poisons which protect the eggs and are passed at mating (Eisner and Meinwald 1995).

1.5. TACTILE COMMUNICATION

This is communication based upon touch (tables 1.8 and 1.9). For example, elephants put their trunks in the mouth of relatives, while social primates groom each other.

ADVANTAGES

1. Fast rate of change of signals.

2. Fast exchange of information.

3. Easy to locate sender because physically present.

4. Low energy costs.

5. Medium complexity of signals; eg: vary touch rate or pressure.

6. Effective in large, close-contact groups, like herds or flocks.

7. Effective in darkness or poor light.

8. No dependent on physiological structures like eyes for visual communication or ears for auditory communication.

DISADVANTAGES

1. Requires physical contact to work.

2. Not able to use when physical obstacles present.

3. Limited durability of signal.

4. Less effective among solitary species.

5. Needs animals to able to move around.

6. Not as fast as vision or hearing (Endler 1993).

7. Not as high information transfer rate as vision and hearing (Endler 1993).

Table 1.8 - Advantages and disadvantages of tactile

communication.

CRITERIA	TACTILE COMMUNICATION
Range/distance	Very low
Rate of change of signal	Medium
Ability to pass obstacles	Limited
Rapid exchange between	Possible
Locatability of sender	Definite
Complexity of signal	Low
Energy cost of communication	Low
Durability of signal	Low
In darkness	Good

Table 1.9 - Effectiveness of tactile communication.

1.5.1. Examples of Tactile Communication

Crickets

Tactile communication is used during courtship and mating as the animals are close together.

Male Mormon crickets give the female a "nuptial gift" which is protein-rich as well containing the sperm. The production of this gift is costly for the male, so they are careful about their choice of female. Females mount the male who weighs them to assess the number of eggs (Gwynne 1981).

Frogs

Mating behaviour in frogs is characterised after copulation by amplexus (the male grasps the female around the middle until the eggs are released) for several hours to weeks.

Certain female qualities will encourage the male to maintain amplexus - silence; firmness (ie: body distended with eggs); and receptiveness to the male's clasp. Females can produce release by the "release call" or vibrating her body after laying the eggs. The soft abdomen now produced is a "turn-off" for the male (Stebbins and Cohen 1995).

1.6. ELECTRICAL COMMUNICATION

A small number of water-dwelling animals use electrical communication (tables 1.10 and 1.11). For example, mormyrid electric fish (Brienomyrus brachyistius) in West Africa communicate through a fixed

electric organ discharge (EOD) with a variable sequence of pulse intervals (SPI)(Carlson and Hopkins 2004).

Carlson and Hopkins (2004) were able to measure the electrical signals and distinguish three types of communication:

i) "Scallops" (EOD of 10-20 msecs) - "advertisement" signals produced by both sexes to show "strength" and "who they are" in relation to dominance;

ii) "Accelerations" (EOD of 25-40 msecs) - aggression signals produced by both sexes in social situations;

iii) "Rasps" ("scallop" followed by "acceleration") - male courtship signals.

ADVANTAGES

1. Most effective over a short range.

2. Ability to go past obstacles.

3. Fast rapid exchange of information.

4. Good way to localise sender.

5. Works in unclear water.

6. Similar to hearing, but smaller frequency range (Endler 1993).

DISADVANTAGES

1. Limited complexity of message.

2. Low durability of message.

3. Only works in water.

4. Not long range.

5. Needs specialist organs to send and receive message.

6. Depends on salinity and conductance (Endler 1993).

Table 1.10 - Advantages and disadvantages of electrical communication.

CRITERIA	ELECTRICAL COMMUNICATION
Range/distance	Low (depends of conductance of
Rate of change of signal	Low
Ability to pass obstacles	Limited
Rapid exchange between	Medium
Locatability of sender	Good
Complexity of signal	Low
Energy cost of communication	High
Durability of signal	Low
In darkness	Good

Table 1.11 - Effectiveness of electrical communication.

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2. REASONS FOR ANIMAL COMMUNICATION

2.1. INTRODUCTION

Animals communicate in many different ways, but also for many reasons. The purpose of communication can be grouped into:

- Communication within the group
- Communication with kin
- Communication related to mating
- Predator-prey communications
- Territoriality signalling

2.2. COMMUNICATION WITHIN THE GROUP

Animals living in groups share information and communicate about different aspects of living. These include:

- Group identity - being members of the group; eg: all bees in swarm share distinctive odour; desert locusts change colour from green (loner) to multi-coloured (social) by touch on hindlegs.

- Aggression and submission in social interactions - who is dominant and submissive in social hierarchy; eg: threat and submission displays; chimpanzees grooming and food sharing.

- Conflict resolution in social interactions - after fights and disputes; eg: chimpanzees reconcile by eye contact, hand gestures, and physical contact.

- Where to find food; eg: bee dance.

- Where to find nest site.

- Synchronised hatching; eg: ducks/geese.

- Individual's emotional state; eg: chimpanzee's facial expressions tell of fear, anger or contentment.

2.3. COMMUNICATION WITH KIN

Communication is important with kin in a number of ways:

- Individual identity - who the individual animal is; eg: dolphins have own "signature whistle"; budgerigar own "signature contact call".

- Mother(parent)-offspring recognition and communication - parents finding offspring at nest when return with food, and offspring communicating state to parent; eg: female giraffes use smell and taste to distinguish young; baby crocodiles chirp before hatching.

- Begging for and offering food; eg: nestlings' begging call and coloured gape when open-mouthed.

- Recognition of mate or kin; eg; monogamous king penguins in large colony; Manx shearwater (birds) recognise call of mates by modifying their calls to that of mates.

2.4. COMMUNICATION RELATED TO MATING

An important area of communication relates to mating:

- Competitive status - particularly among males; eg: male red deer grow antlers during breeding season;

- Communication of "good genes" to potential mates - this is usually done by males to females in some way like body size, strength of calling, or body ornaments (eg: peacock's tail);

- Sexual interest and status - females release chemical signals when "on heat" (ie: sexually receptive).

- Courtship displays.

2.5. PREDATOR-PREY COMMUNICATION

Predator and prey communicate in different ways including:

- Alarm calls; some species have different calls depending on the type of predator. Alarm calls not only warn other prey, but also tell the predator that they have been spotted. This is important for predators that use stealth;

- Deception; prey use techniques like mimicry to deceive the predator.

2.6. TERRITORIAL SIGNALLING

Animals need to communicate in relation to their territory, in terms of boundaries, chasing and fighting intruders, in establishing and maintenance of the territory; eg: dogs mark boundary of home range with scent in urine.

3. COMMUNICATION AND THE SOCIAL TRANSMISSION OF INFORMATION IN GROUPS

3.1. INTRODUCTION

Animals in groups communicate information to each member in a number of ways and for different reasons. For example, visual communication of food availability or presence of predations by head movements of birds.

3.2. PRESENCE OF PREDATORS

Alarm calls are the most common way of signalling the presence of predators. Acoustically different alarm calls for different predators have been observed in vervet monkeys (Cercopithecus aethiopos). For example, an aerial predator alarm call causes the listeners to climb down the tree and scan the sky, while the snake alarm call makes the listeners stand upright on two legs and scan the ground (Seyfarth et al 1980).

Some other species of non-human primates, like chacma baboons (Papio cynocephalus) vary the general alarm call slightly for different predators, but this does not produce different responses in the listeners. While redfronted lemurs (Eulemur fulvus), for example, have specific alarm calls for aerial predators and general alarm calls for other threats. Listeners respond by looking in the direction of the caller (Fichtel et al 2005).

Fichtel et al (2005) investigated the alarm calls of white-faced capuchin monkeys (Cebus capucinus)(figure 3.1.) in Costa Rica. These are small monkeys (2.5-3.5 kg; 5-8 lbs), and are vulnerable to many different types of predators.

Alarm calls (n = 532) by 49 different individuals were recorded. They included responses to aerial predators (eg: falcons), humans, other monkeys, terrestrial predators (eg: puma), snakes (boas), and caimans. The calls were analysed in terms of duration and frequency range.

The following responses were observed to different predators:

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* Snakes - the main responses to this call from listeners were to look at the caller, approach caller, run up tree, or produce aggressive response towards the snake.

* Aerial predators - looking at the caller was the initial response, and looking up.

* Humans - unfamiliar humans produce the response of running up the tree.

* Terrestrial predators - there was an aggressive response (shaking branches and intense vocal threats) from up in the trees.

(Source: David.M.Jensen (Storkk))

Figure 3.1 - White-faced capuchin monkey.

* Caimans - the response here was an extreme version of the response to snakes.

* Other monkeys - the group fled in the direction they had come, while some males moved towards the intruder(s).

Fichtel et al's acoustic analysis distinguished two categories of alarm calls. The first in response to aerial predators, humans, and other monkeys, and the other for terrestrial predators and snakes. Each category had sub-types. "Predators associated with the first category are fast moving and require different specific and immediate escape strategies, whereas predators associated with the second category are not that dangerous once detected" (Fichtel et al 2005 p172).

The presence or absence of predators can also be communicated by physical movements. House finches (Carpodacus mexicanus)(figure 3.2) show two types of head movement when on the ground looking for food - short head-up bouts to signal unsuccessful foraging, and long head-up bouts for successful foraging. Fernandez-Juricic et al (2006) manipulated these signals using robot finches. The seed consumption and pecking rate among live birds was influenced by the behaviour of the robots.

When the robots showed long head-up bouts, seed consumption averaged 0.70g with a pecking rate of 10 per minute compared to 0.40g and eight respectively when the robot mimicked short head-up bouts.

3.3. FINDING FOOD

In social insects, individuals who find food need to communicate this to other foragers. This is done in a number of ways in different species:

* Wasp (Polybia occidentalis) - mandibular contact ("biting")(O'Donnell 2001)(tactile)

* Honeybees - waggle dance of returning foragers (Von Frisch 1993)(visual)

* Ants - trail pheromones (Hölldobler and Wilson 1990)(chemical).

This tends to show the foragers where to go, but what stimulates the ants to leave the nest? Schafer et al (2006) investigated red harvester ants (Pogonomyrmex barbatus)(figure 3.3) that live in the deserts of southwestern USA, and Mexico. Foraging involves collecting seeds. It seems that the stimulation of inactive foragers at the nest by returning successful

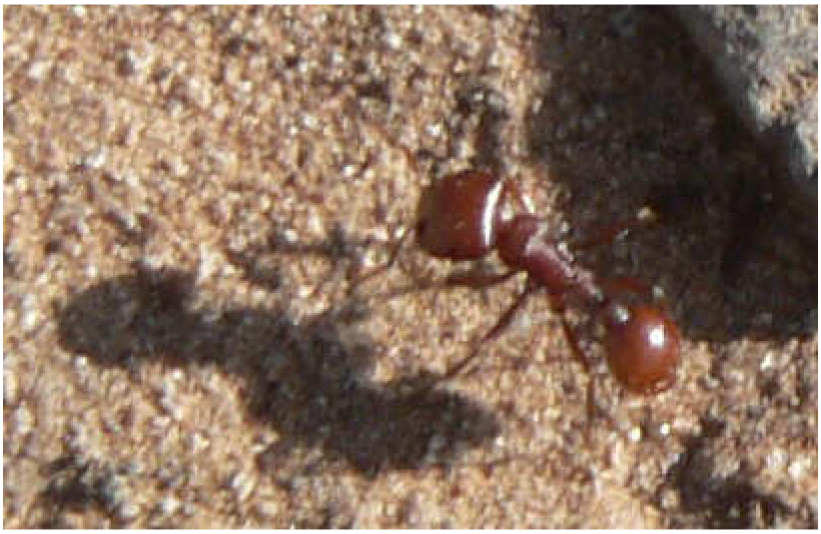
(Source: Mathew Hunt (Coneslayer))

Figure 3.2 - Male house finch.

foragers is partly due to chemical signals (cuticular hydrocarbons)(Wagner et al 2001).

Schafer et al counted the number of foragers leaving the nest and the numbers of successful and unsuccessful foragers returning for one minute at two minute intervals. Returning ants (both successful and unsuccessful) were removed before reaching the nest to see the effect.

The removal of returning successful foragers, but not unsuccessful ones, reduced the rate at which new foragers left the nest. Returning successful foragers meant that food is plentiful, and thus the need for



(Source: Unknown; in public domain)

Figure 3.3 - Red harvester ant.

assistance in collecting it. Unsuccessful returns meant that food is lacking and no need for other ants to go out (and risk predation). The inactive foragers are probably stimulated by the smell and sight of food.

Karl von Frisch (1974), after fifty years of research, described how honeybees (Apis mellifera) communicated the presence and direction of food sources through movements called "dance language". The first part is the "round dance", where the bee turns in a circle and then reverses the direction of travel a number of times, to signal that a food source has been found. The second part, called the "waggle dance", involves walking in a straight line while vigorously wagging the body. This provides information about the direct and distance of the food source (Gardner et al 2008).

von Frisch emphasised the two parts of the dance because, initially, he believed they signalled different food sources - round dances for nectar and waggle dances for pollen (Gardner et al 2008).

The idea of two distinct parts of the bee dance has been questioned by subsequent research. For example, round dances contain information about distance when the food source is very close (Kirchner et al 1988). Gardner et al (2008) have gone further and suggested that the round and waggle dances are just variations on one signal - the "adjustable waggle dance".

The bee dance is studied experimentally by placing sugar water at different distances and directions from the hive, and then observing the dance of the returning

foragers. von Frisch (1993), who pioneered this method, observed the bees himself, whereas today the hive activity is video-recorded. Gardner et al (2008) set the sugar water at ten distances from the hive (10, 30, 50, 70, 100, 150, 200, 300, 400, and 500 metres).

3.4. FINDING KIN

Individual animals living within large groups need to find other individuals. Communicating one's position within the group to another individual is difficult as the group becomes larger.

In the case of king penguins (Aptenodytes patagonicus)(figure 3.4), the colony may vary from hundreds to hundreds of thousands. These birds pair monogamously to breed, incubate and brood the young. Each parent takes it in turn to forage for food in the sea while the other incubates the egg on its feet. Thus movement within the group occurs while the other parent is away foraging (average of 5 metres in three months)(Lengagne et al 1999).

Acoustic communication between parents is more effective than visual communication in this situation. The returning forager calls several times at different distances from the group, and the incubating mate replies. But this is not done in silence, it is against the background of similar calls producing a "jamming effect" (Aubin and Jouventin 1998).

Lengagne et al (1999) investigated, through observation and experiment, the calls between mates in a king penguin colony of 40 000 pairs at Possession Island [1]. Twenty-eight pairs were marked with numbered plastic flipper bands to aid identification by the researchers during the observation in December 1994 to February 1995. Recordings of the calls were also made, and played back at distances of 20, 15, 14, 13, 12, 11, 10, 9, 8, and 7 metres from the brooding bird.

A number of measures were calculated:

- Distance of First Emission (DFE) - distance between two mates when the returning foragers makes the first call;
- Number of Display Calls emitted by Arriving bird (NCA);
- Number of Display Calls emitted by Incubating bird (NCI);
- Time Delay (TD) between first call and two mates meeting.

[1] Part of the Crozet Islands in the Indian Ocean, north of Antarctica.

(Source: Samuel Blanc)

Figure 3.4 - King penguins.

The calls were most effective at an average distance of 8.8 metres with twelve metres being the maximum distance. The DFE was less than 8 metres for the majority (67%) of birds. The returning mate needed an average of five calls (NCA) and a mean of 114 seconds (TD) to find partner. The NCI was not related to the NCA. Overall, it was estimated that 70.17% of incubating birds were able to discriminate the first call of their mates.

The returning mate heads for the general area where the mate was left, called the "attachment zone" (Barrat 1976 quoted in Lengagne et al 1999), probably using topographic cues. Then within a few metres, they call out.

Acoustic communication has a number of advantages over visual communication in this situation (table 3.1).

ACOUSTIC COMMUNICATION	VISUAL COMMUNICATION
• Sound transmitted in all directions • Wider range of broadcast (to over 500 birds; Lengagne et al 1999) • But background noise (69-74 dB; Lengagne, Aubin et al 1999) • But requires individually-specific signals that can be	Problems: • Individual birds look similar • Narrow field of projection • Needs birds to look at each other • Handicapped by obstacles

Table 3.1 - Acoustic versus visual communication in a large colony of birds.

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4. WEB-SEARCH ACTIVITY: ANIMAL CALLS

This activity aims to find recordings of animal calls and different types of calls using the Internet.

1. Find examples of calls by:

- Birds
- Mammals
- Insects
- Crustaceans

2. Find example of different calls by the same animals:

- Alarm calls
- Mating calls
- Territorial calls

3. Useful websites

- General info: Animal Communication Project http://acp.eugraph.com/index.html

- List of online sound collections http://www.ibac.info/links.html#online

- Listen to Nature (British Library) http://www.bl.uk/listentonature/main.html

- General bird http://askabiologist.asu.edu/expstuff/experiments/birdsongs/

- Bird song from Americas http://www.xeno-canto.org/

- All animals http://macaulaylibrary.org/index.do

- Animals including dolphins http://www.seaworld.org/animal-info/sound-library/index.htm

5. LANGUAGE AND THE CALLS OF TWO DIFFERENT ANIMALS

5.1. INTRODUCTION

Animal calls can be quite sophisticated, but in order for them to be seen as a language (as used by humans) they must fulfil certain criteria. Hockett (1960) proposed sixteen criteria based on human language (table 5.1). In practice, the key criteria for language are semanticity, displacement, openness, and reflectiveness.

Two species who use auditory communication, crickets and robins, are presented as examples of sophisticated calling.

5.2. CRICKETS

Crickets (figure 5.1) communicate by sound exclusively. Alexander (1968) listed different functions of sound communication for crickets:

- calling signals (pair forming and congregation);
- aggression signals (rival separating and dominance establishment);
- courtship signals;
- courtship interruption signals; eg: when courtship rebuffed;
- copulatory signals;

Table 5.2 outlines the main characteristics of the male cricket's song.

CRITERIA OF LANGUAGE	DESCRIPTION
1. Vocal-auditory channel	Uses sound
2. Broadcast transmission and	Direction of communication
3. Rapid fading of message	Sound disappears
4. Interchangeability	Both transmitter and receiver use
5. Complete feedback	"Speaker" able to perceive own
6. Specialisation	Energy produced by sound not as
7. Semanticity	Different signals have different
8. Arbitrariness	Symbols have abstract meaning
9. Discreteness	Each sound separate
10. Displacement	Able to refer to objects not
11. Openness	Ability to create new messages
12. Tradition	Passed on by learning
13. Duality of patterning	Individual elements meaningless
14. Prevarication	Ability to lie or talk nonsense
15. Reflectiveness	Ability to talk about talk
16. Learnability	Speaker of one language to learn

Table 5.1 - Hockett's (1960) criteria of language.

- "window of hearing"; ie: specific frequency (4-5kHZ)
- interval between calls (rate of emission) eg: 10ms gap
- song automatic; ie: genetically programmed
- song is species-specific
- calling signals quality of male and their genes:
  - length of calling
  - volume of song
  - method of producing call is clue to quality of specialised wings and their symmetry

Table 5.2 - Characteristics of male cricket's song.

(Source: Ghouston)

Figure 5.1 - A field cricket.

The male produces a song by stridulation - much of which is ultrasonic, while the female is usually silent (ie: does not call). Usually during singing, the left wing with its "stridulatory file" (row of teeth-like formations) is scratched over a raised vein on the right forewing (Rust et al 1999). This is stridulation.

This process does not make much sound, so a system of amplification is required. One method used is by the tegmina (modified fore wing), while mole crickets have a horn-shaped burrow which acts as a sound enhancer (Gullan and Cranston 2000).

The song serves the function of repelling male competitors, and attracting receptive females. The song is usually species-specific.

5.2.1. Circadian Rhythms in Calling

Male crickets call to attract males at roughly the same time every day - early evening. Experiments keeping crickets in a controlled environment of 12 hours light and 12 hours darkness found that after a period of adjustment, the crickets would start to call two hours before darkness and continue until two and half hours before light.

While those kept in constant darkness, singing begins at intervals of 23.5 hours and lasts the normal period. In constant light, the interval is 25.3 hours (Loher 1972). This is an endogenous rhythm; ie: partly independent of environmental signals.

Calling at night occurs because this is the time when females move around.

It appears that visual signals help the cricket to keep their calling in rhythm. If the optic nerve is cut, the calling period changes each day (Johnson and Hasting 1986).

5.2.2. Length of Calling

There are differences in the length of calls of male crickets: some call for many hours through to others who rarely sing. Cade (1981) selectively bred long and short callers over four generations. The difference in length of calls was found to be genetic, as shown by the results summarised in table 5.3.

APPROXIMATE PERCENTAGE OF OFFSPRING

MEAN CALLING TIME (hrs)	SHORT CALL OFFSPRING		LONG CALL OFFSPRING	
generation	1st	4th	1st	4th
0.5	30	0	56	0
1.5	20	4	28	10
2.5	4	6	10	0
3.5	8	12	0	15
4.5	28	10	4	15
5.5	4	12	2	8
6.5	6	15	0	8
7.5	0	12	0	4
8.5	0	25	0	30
9.5	0	4	0	10
10.5	0	0	0	0

(Data from Cade 1981)

Table 5.3 - Summary of results from breeding studies by Cade (1981).

The length of song has been found to be a key for female attraction. Hedrick (1986) used a common experimental technique of two speakers in opposite parts of the room, each playing a different call. One speaker played a long running call, the other played short bouts of song. In 23 of 25 trials, females moved towards the long-running call, suggesting female preference for this attribute.

To call continuously shows evidence of evolutionary fitness and thus "good quality" genes in the male.

The quality of song is also linked to the symmetry of the male's body (McGavin 2001), and symmetry is seen as a key signal of "good genes".

5.2.3. Other Characteristics of Communication

It is the volume and rate of emission that is key, and a number of different messages can be thus communicated. Alexander (1962) recorded five different calls by one type of cricket (Teleogryllus commodus) (as described in table 5.4).

TYPE OF CALL	kHZ	DESCRIPTION IN ONE SECOND OF TIME
CALLING	4	equal distance longer calls
ENCOUNTER	3-4	individual call similar in length to above but grouped as short bursts, pause, longer burst, pause, short burst
FIGHTING	6/4-5	initially at higher kHZ, then steady bursts of equal distance at lower frequency
TRANSITION TO COURTSHIP	4	short bursts build up, and even then steady song
COURTSHIP	4	short steady calls

(After Alexander 1962)

Table 5.4 - Different cricket calls recorded by Alexander (1962).

5.2.4. Genetic Control of Behaviour

Selective breeding and cross-breeding of species (eg: Teleogrillus commodus with Teleogrillus oceanus; Bentley 1971) show that individual song characteristics are determined by specific genes.

Further evidence that the mechanism of control of the call is genetic comes from isolation studies. Here animals are kept separate from their species from birth, and thus cannot hear the normal call. Male crickets kept in isolation sing a normal song at the appropriate time (Bentley and Hoy 1974).

Also crickets deafened at birth still make stridulation even though unable to hear the call.

Severing the wings does not effect the male's call. It seems to be resistant to environmental modification (Alexander 1968).

The rate of calling tends to be automatic also. Heiligenberg (1966 quoted in Hinde 1970) has shown how the call response is a stimulus-response relationship; ie: the rate of calling affected by the calls heard by the cricket. This would make sense as calling is a key means of male competition and signalling who is best to the female. Captive house crickets were played calls at a rate of every 2.5 or 0.625 seconds, or none at all (control group). The captive crickets rate of calling was then recorded. Table 5.5 shows that the more frequent the calls heard, the faster the reply.

It can be seen that singing is ritualised aggression and competition between males where tympanal organs (hearing mechanisms) are destroyed (ie: the cricket can no longer hear its own singing).

AVERAGE NUMBER OF CHIRPS IN ONE SECOND INTERVAL

no stimulation	15
2.5 second stimulation	29
0.625 second stimulation	33

(After Hinde 1970)

Table 5.5 - Summary of findings from Heiligenberg (1966).

Though the cricket is able to communicate different messages, it would be wrong to class it as a language. Table 5.6 compares cricket communication with human verbal language using the criteria of a language from Hockett (1960).

On the key criteria of language, male cricket calls have partial semanticity, but not the others like displacement and openness.

CRITERIA OF LANGUAGE	CRICKET COMMUNICATION
1. vocal-auditory channel	auditory, but not vocal
2. broadcast transmission and directional reception - direction of communication controllable	yes
3. rapid fading of message	yes
4. interchangeability - both transmitter and receiver use same symstem	partial (female of species rarely sing)
5. complete feedback - "speaker" able to perceive own signal	yes
6. specialisation - energy produced by sound not as important as effect of sound	yes?
7. semanticity - different signals have different meanings	partial
8. arbitrariness - symbols have abstract meanings	?
9. discreteness - each sound separate	yes
10. displacement - can refer to objects not physically present	-
11. openness - new messages created	no
12. tradition - passed on by learning	no
13. duality of patterning - individual elements meaningless until combined	?
14. prevarication - ability to lie or talk nonsense	no
15. reflectiveness - ability to talk about talk	no
16. learnability - speaker of one language to learn another	no?

(After Thorpe 1972, 1974)

Table 5.6 - Characteristics of human verbal language compared to cricket communication.

5.3. ROBINS

Robins (Erithacus rubecula)(figure 5.2) communicate by sound and the use of the red-breast as visual

communication. The red is used as a warning when birds stray into the territory of the resident.

(Source: Unknown; in public domain)

Figure 5.2 - A robin.

Kevin Brewer; 2009; ISBN: 978-1-904542-40-7

The sound communication takes place within the range of 2-9 kHz, and shows a difference in complexity between the "races" of robins.

The song begins with very high notes, checks, and goes bounding off again - "tic-ic-ic" ("sounding like an old grandfather clock being wound up") (Bruun et al 1992). The song will be different in autumn and winter compared to spring. The autumn and winter songs are usually quieter. The sequence of notes sung by the males is important for recognition of the same species (Bremond 1968 quoted in Wilson 1975).

One study of three males and one female recorded them using over one hundred different songs, and the birds shared only three of them (Hoelzel 1986 quoted in Harper 1988b).

Singing is the means by which males attract females, and the quality of the song is a sign of the quality of the genes. It is also a means of male-male competition. Most song-bouts occur from a perch rather than in flight (Harper 1988a).

5.3.1. Circadian Rhythms and Singing

There is a circadian rhythm to the singing - mainly at dawn, but also at dusk.

This rhythm is affected by the temperature of the environment, and thus the body temperature of the bird. Thomas (1999a) has shown a positive correlation between the amount of time spent singing and the environmental temperature. At lower temperatures, the bird needs to forage more, which leaves less time for singing. Singing at dusk is also linked to reserves of energy to survive the night. Based on the current temperature, the bird will sing in relation to the current and expected future energy expenditure.

The reliability of the food supply also influences singing at dawn and dusk. This is linked to whether the food supply is constant or variable. The bird uses the size of its fat reserves as an indicator of energy stores and then predicts the needs of the day (Houston and McNamara 1987).

Thomas (1999b) set up an experiment to vary the food supply, and then recorded the amount of singing at dawn and dusk. There was either a constant food supply, or it was varied to be plentiful one day and then scarce the next. The song rate was measured as the number of songs per hour. The results appear in table 5.7.

	DAWN	DUSK
FOOD SUPPLY VARIABLE	180	180
FOOD SUPPLY CONSTANT	250	140

(After Thomas 1999b)

Table 5.7 - Approximate number of songs per hour.

Generally when the food supply is variable, there is less singing at dawn then dusk, and more singing at dawn when the food supply is constant. In other words, birds sing more at dawn when the fat reserves are high (Thomas and Cuthill 2002). This is a signal to females of a well-fed bird (with good territorial resources).

5.3.2. Singing and Aggression

Singing acts as a form of contest between males. Usually the birds will alternate their songs, but in certain situations, they will overlap. Overlapping of the other bird's song is an indicator of a high level of arousal or willingness to escalate the contest by a male, particularly when the opponent is close to the singer. Dabelstein et al (1997) used a playback experiment to assess the amount of twitterings (continuous, low amplitude pattern of singing) in male robins. Twitterings are the sign of arousal.

The experiment involved three conditions of playback:

a) alternating interactive playback - playing a recording of a male song in response to the song heard;

b) overlapping interactive playback - playing a recording that overlaps with the singing male;

c) non-interactive loop playback (control condition) - playing a recording constantly, and irrelevant of any birds singing.

The number of twitterings per playback were noted (table 5.8). Overlapping of the other male's song is an aggressive tactic by males.

	AVERAGE NUMBER OF MALE TWITTERINGS
NON-INTERACTIVE LOOP PLAYBACK	0
ALTERNATING INTERACTIVE PLAYBACK	3
OVERLAPPING INTERACTIVE PLAYBACK	9

(After Dabelstein et al 1997)

Table 5.8 - Number of male twitterings based on playback in experiment by Dabelstein et al 1997.

Robins call for other reasons than aggression. Harper (1988b) listed the different types of calls recorded by robins (table 5.9).

There are a wide variety of calls that have been recorded, but are they the same as those used in a language? There are a number of criteria that have to be satisfied before communication can be called a language (table 5.10). Generally it is not the same as the use of language by humans because, in particular, there is no openness and reflectiveness, and displacement is probably limited if not unlikely.

5.4. CONCLUSIONS ON LANGUAGE

Noam Chomsky (1965) believed that language was unique to humans. Animals communicate in various ways, but it is difficult to call it language, not because they do not use words, but because the criteria for a language (vocal or not; eg: American Sign Language) are not fulfilled.

The key issues for any system of animal communication can be reduced to semanticity, creativity, and displacement.

- Semanticity - Some animals have specific calls for particular types of predators, and most animals have different calls for different motivations, like alarm or mating. But each human word relates to a specific object.

- Creativity - The ability to produce entirely new combinations of elements of communication is rare in any species. Whereas human words can be combined to produce a sentence that has never been heard before.

- Displacement - Alarm calls, for example, warn of the presence of a predator in the now. Displacement is the

TYPE OF CALL	FREQUENCY (kHZ)	WHEN CALL GIVEN
tic-call	3-6	short, sharp "tic" sound; to warn of territory or alarm, particularly mammal predators
contact-alarm call	7	thin "tswee" sound; mild alarm when bird wanders off territory, encounters novel object, territory being established, non-antagonistic meetings
alarm-call	7	high-pitched, sharp sound; in presence of predators, particularly avian
antagonistic calls	7.5	one for dominant bird, one for subordinate
contact-call	7	given when two birds meet
feeding-call	6-7	begging call given by females when mate is courtship feeding; also heard when searching for mate, or by subordinate robin
copulation-call		similar to contact-call, given by female at mounting
foraging-call	8	
flight-call	6-7	given by nocturnal migrants
churring-call	3-6	made by adults tending nest
brooding-call		given by female during incubation and brooding; similar to contact-call and churring-call
sigh-call		made during fight or when cornered by predator
hiss-call	7	heard during fights
distress-call	5-7	made when seized by predator
juvenile calls		calls from chicks in eggs, and young nestlings before produce recognisable adult versions
miscellaneous		bill-snapping sound made during fights

Table 5.9 - Different types of calls made by robins.

CRITERIA OF LANGUAGE	CALLS OF ROBINS
1. vocal-auditory channel	yes
2. broadcast transmission and directional reception - direction of communication controllable	yes
3. rapid fading of message	yes
4. interchangeability - both transmitter and receiver both use same system	yes
5. complete feedback - "speaker" able to perceive own signal	yes
6. specialisation - energy produced by sound not as important as effect of sound	yes
7. semanticity - different signals have different meanings	seems so
8. arbitrariness - symbols have abstract meanings	time - no space - yes
9. discreteness - each sound separate	yes
10. displacement - can refer to objects not physically present	some possibly
11. openness - new messages created	probably not
12. tradition - passed on by learning	no
13. duality of patterning - individual elements meaningless until combined	?
14. prevarication - ability to lie or talk nonsense	no
15. reflectiveness - ability to talk about talk	no
16. learnability - speaker of one language to learn another	no?

(After Thorpe 1972, 1974)

Table 5.10 - Characteristics of human verbal language compared to calls of robins.

ability to communicate about something that is not physically present - to refer to the predator who came yesterday or will return tomorrow.

Animal systems of communication can be complex, but language (as used by humans) is so much more complex.

Cheney and Seyfarth (1997), who have studied different calls by vervet monkeys, concluded that the:

> communication of nonhuman animals lacks three features that are abundantly present in the earliest words of young children: a rudimentary theory of mind, the ability to generate new words, and syntax (p198).

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6. STUDYING ANIMAL COMMUNICATION WITH DIFFERENT RESEARCH METHODS

6.1. INTRODUCTION

Animal communication can be studied in different ways and using different research methods. The methods used vary in the amount of interference of the animal's natural communication. Experiments directly manipulate variables to see the effect, whereas observations do not interfere.

Here are four different examples of research methods involving degrees of interference with the communication process.

6.2. AUDITORY COMMUNICATION: LABORATORY EXPERIMENT - Leonardo and Konishi (1999)

Background

Young birds need to hear their species' song (auditory feedback) in order to develop normal songs. The completion of song development is known as crystallization. Birds who are deafened when young do not achieve crystallization. It is assumed that once crystallization has occurred, the adult bird's song remains unaffected.

Aim

To see if adult birds' song is influenced by hearing other adults sing.

Method

This experiment used five adult zebra finches (Taeniopygia guttata) in a repeated measures design. The birds were placed individually in a sound chamber where their song was recorded, then played back to the bird in a changed form. This was the first condition. The second condition involved playing back the correct song of the birds. The whole experiment took up to 20 months.

Results

After the first condition, four of the five birds showed decrystallization; ie: their song had become abnormal with stuttering, creation (added "syllables"), deletion (missing "syllables") and distortion. The second condition led to the recovery of the original song.

Conclusion

"Our results demonstrate that zebra finches need auditory feedback to maintain their songs in adulthood" (p469).

Evaluation of Laboratory Experiment

ADVANTAGES

1. Establish cause and effect relationship between variables.

2. Control of participants and variables.

3. Replication possible because of standardised procedures used.

DISADVANTAGES

1. Low ecological validity; ie: artificial study of behaviour.

2. Narrowness of independent and dependent variables.

3. Measures behaviour for short limited period only.

6.3. AUDITORY COMMUNICATION: FIELD EXPERIMENT - Forsman and Monkkonen (2001)

Background

One anti-predator strategy used by prey is to make mobbing calls. An individual prey who spots a predator or is being attacked makes this call which attracts other prey.

For example, a mobbing call by a small bird attracts many other small birds of different species to the caller. It is assumed that a large number of birds coming together will reduce the individual risk of being attacked (the dilution effect).

Aim

To see the effect of the mobbing calls of willow tits Poecile montanus) and redwings (Turdus iliacus) on other small woodland birds.

Method

The researchers recorded genuine mobbing calls of the two species, and also their territorial songs. With a control recording of classical music, this gave the researchers five different recordings to use. Randomly one of the five tapes were played in a Finnish woodland for ten minutes per day at the same time of day, and the researchers counted the number and types of birds attracted by the recordings.

Results

The mobbing calls attracted more birds than the territorial songs, and this was more than the control tape. The mobbing calls were more likely to attract smaller birds than larger ones.

Conclusion

The mobbing calls of willow tits and redwings attracted other smaller birds.

Evaluation of Field Experiment

ADVANTAGES

1. Natural settings used; ie: high ecological validity.
2. Certain topics not possible to study in lab environment.

DISADVANTAGES

1. Less control over variables and participants than lab experiment.
2. Replication difficult.

6.4. VISUAL COMMUNICATION: NATURALISTIC OBSERVATION - Jennings et al (2003)

Background

Males competing for females can lead to male-male aggression. Fighting has high risks of injury for the males. So threat displays (visual communication) have evolved by which animals can show their "strength" and "quality" without the need for actual aggressive contact.

One such threat display is the parallel walk by male deer. This involves the males walking side-by-side to show their body size and resolve conflicts without physical contact.

Aim

To see if parallel walking among male fallow deer (Dama dama) reduces the amount and duration of fights during the mating season.

Method

This study is based on observations of the fallow deer population in Phoenix Park, Dublin, and the videotaping of a sample of fighting behaviour. A total of 3296 contests between males (4 years or older) were observed in September-October 1996 and 1997. 189 fight sequences were sampled for study.

The researchers had a coding frame (defined categories) for the behaviour being observed - fight ("interaction that involved antler contact"); parallel walk ("two individuals interacted by walking parallel in close proximity to each other").

Results

A total of 50.8% of all the fights included parallel walking (before/during or after physical contact). Of the video-sampled fights, more of them were not resolved by a parallel walk prior to fighting (34 to 21), and more fights were resolved before contact without parallel walking (42 to 24). The time spent fighting was also not shorter with the presence of parallel walking then when not present.

Conclusion

The researchers could not support their hypothesis, and found that parallel walking was not associated with less fighting. "Fighting duration and rate of engagement in risky behaviour is not related to the presence or absence of a parallel walk" (p1010).

The researchers note that parallel walking occurred often after a fight had started, and suggest an alternative reason for their findings: "the parallel walk may permit weaker animals to withdraw from fighting after a period of direct physical assessment and thereby limit exposure to risky activity" (p1010).

Evaluation of Naturalistic Observation

ADVANTAGES	DISADVANTAGES
- Natural environment observed	- Lack of control or causality
	- Difficulties of measurement
- Means of identifying new problems/hypotheses	- Some aspects of behaviour not observable
- Where fuller picture of behaviour needed than in experiment	- Important behaviour may be missed
- Describe chronology of behaviour	- Difficult to replicate
- Subtlety of interaction can be observed	

6.5. VISUAL COMMUNICATION: OBSERVATION WITH SOME INTERFERENCE - Thusius et al (2001)

Background

Within evolutionary theory is the concept of "female choosiness". This means that females of the species decide which are the best males for them to mate with. Thus males must show the "quality" of their genes in some way.

For the male common yellowthroat (Geothlypis trichas)(small North American bird), it is the size of the "face mask" (black patch on the face).

Aim

To see if male yellowthroats with larger "face masks" fathered more offspring than those with smaller "face masks".

Method

Male yellowthroats at 59 sites were individually caught. The size of the "face mask" was measured after being videotaped for each bird, and blood samples were taken for "DNA fingerprinting". This would allow determination of the fathers of the offspring. The birds were also measured, and given leg bands to identify them. The size of the "face mask" was measured to the nearest square centimetre using two pictures of each side of the head.

The researchers were later able to take blood samples of the chicks to determine the father.

Results

The number of offspring has a positive correlation with the size of the male's "face mask". So the "face mask" is a honest visual signal of male quality.

Conclusion

Male large "face mask" size is a way to attract females in the common yellowthroat bird.

Evaluation

a) Catching the birds to take their details is an intervention that might influence the bird's behaviour. So this is not a complete naturalistic observation.

b) Taking blood samples of the birds is invasive, and can be stressful to the birds.

6.6. REFERENCES

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